

EXTC Per V Per.
Random Signal Analysis

(3 Hours)

[Total Marks : 100

- N.B.** (1) Question No. 1 is **compulsory**.
 (2) Attempt any **four** questions out of remaining **six** questions.
 (3) Assume any suitable data wherever **required** but justify the **same**.

1. Attempt any **four** questions.

- (a) State the Chebyshev's Inequality and explain. 5
 (b) What do you mean by steady state distribution of Markov Chain ? 5
 (c) Suppose X and Y are two Random variables when do you say that X and Y are 5
 (a) Orthogonal (b) Uncorrelated.
 (d) What is the difference between a Random Variable and Random Process ? 5
 (e) State and explain Baye's Theorem. 5

2. (a) A certain test for a particular Cancer is known to be 95% accurate. A person submits 10
 to the test and the result are positive. Suppose that the person comes from a population
 of 100,000 (one Lakh), where 2000 people suffer from that disease.

What can we conclude about the probability that the person under test has that
 particular cancer ?

(b) Explain with suitable examples Continuous, Discrete and Mixed type Random variable. 10

3. (a) Explain the concept of conditional probability and the properties of conditional 10
 probability.

(b) Suppose that 3 balls are randomly selected from a urn containing 3 red, 4 white 10
 and 5 blue balls. If we let X and Y denote respectively the number of red and white
 balls chosen.

Find :- (i) The Joint probability distribution of (X, Y)

(ii) Probability Mass Function of X.

(iii) Probability Mass Function of Y.

4. (a) Suppose $f_X(x) = \frac{2x}{\pi^2}$, $0 < x < \pi$ 10

and $y = \sin x$ Determine $f_Y(y)$. 10

(b) Compare PDF of Binomials and Poisson Random Variable.

A space craft has 100,000 components. The probability of any one component being
 defective is 2×10^{-5} . The mission will be in danger if five or more components
 becomes defective. Find the probability of such an event.

[TURN OVER

Con. 7039-GS-8778-13.

2

5. (a) Define Central Limit theorem and give it's significance. 5
 (b) Describe the sequence of Random variables. 5
 (c) State and prove Chapman - Kolmogorov equation. 10
6. (a) Explain what do you mean by ? 10
 (i) Deterministic system
 (ii) Stochastic system
 (iii) Memoryless system.
 Prove that if Input to memoryless system is strict sense stationary (SSS) process $x(t)$, then output $y(t)$ is also SSS.
- (b) If a Random process $\{x(t)\}$ is given by $x(t)=10 \cos(100t + \theta)$ where θ is uniformly distributed over $(-\pi, \pi)$, prove that $\{x(t)\}$ is correlation Ergodic. 10
7. (a) Explain power spectral density function. State it's important properties and prove any one of the property. 10
 (b) Consider a Random process $x(t)$ that assumes the values ± 1 . Suppose that $x(0) = \pm 1$ with probability $1/2$, and suppose that $x(t)$ then changes polarity with each occurrence of an event in a Poisson process of rate α . 10
 Find the mean, variance and Auto Covariance of $x(t)$.
